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(71) [Applicant]
[ID number] 000133227
[Name or Designation] Tamron Corporation
(74) [Agent]
[ID No.] 100082005
[Patent Attorney]
[Name or Designation] Yoshio KUMAKURA
(74) [Agent]
[ID No.] 100067013
Patent Attorney
[Name or Designation] Fumiaki OTSUKA
(74) [Agent]
[ID No.] 100065189
[Patent Attorney]
[Name or Designation] Yoshikazu SHISHIDO
(74) [Agent]
[ID No.] 100082821
[Patent Attorney]]
[Name or Designation] Atsuo MURAKOSO
(74) [Agent]

[ID No.] 100088694
[Patent Attorney]
[Name or Designation] Takeshi DESHIMARU
(74) [Agent]
[ID No.] 100103609
[Patent Attorney]
[Name or Designation] Sari INO
(72) [Inventor]
[Name] Takashi ITOHIYA
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2K103
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2K103AA16
2K103AB10
2K103BC23
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2K103CA15
2K103CA26
2K103CA29

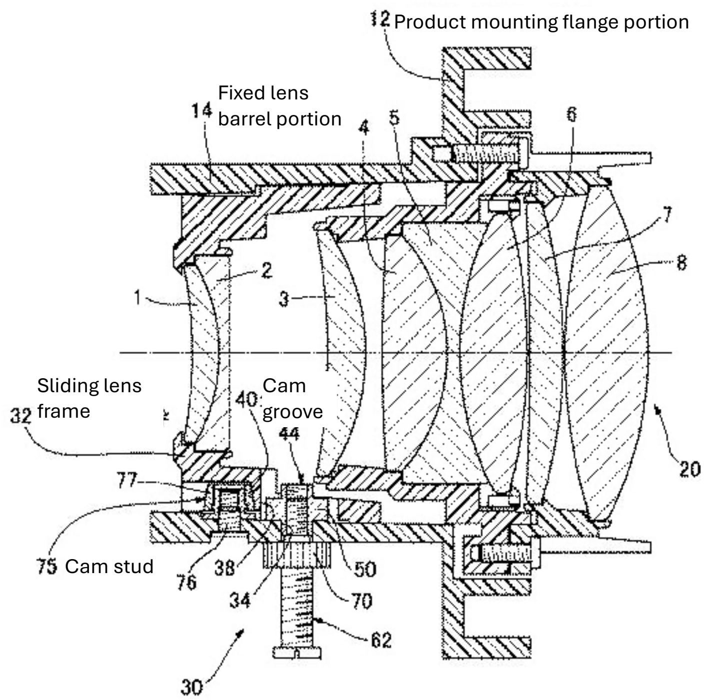
(57) [Abstract]

To provide an optical device with which at least a portion of a lens system can be easily precisely adjusted, and with which at least a portion of the adjusted lens system can be stably affixed without the risk of causing eccentricity.

[Solution Means]

An optical device wherein a sliding lens frame is disposed to slidably move relative to a fixed lens barrel in the optical axis direction and in the rotational direction around the optical axis, the fixed lens barrel and sliding lens frame are engaged by a cam, and the sliding lens frame is moved by rotating the sliding lens frame relative to the fixed lens barrel; wherein by engaging an affixing screw member to the sliding lens frame and clamping the fixed lens barrel portion using two clamping members engaged to said affixing screw member, the affixing screw member is affixed to the fixed lens barrel, and the sliding lens frame is affixed to the fixed lens barrel.

Selected Figure: FIG. 2



[Claim 1]

An optical device for moving a slidable lens frame providing a sliding lens frame capable of sliding relative to a fixed lens barrel in the optical axis direction and in the rotational direction around the optical axis, wherein the fixed lens barrel portion and the sliding lens frame are cam-engaged, and the sliding lens frame is moved by rotating the sliding lens frame relative to the fixed lens barrel;

wherein by engaging an affixing screw member to the sliding lens frame and clamping the fixed lens barrel portion using two clamping members engaged to said affixing screw member, the affixing screw member is affixed to the fixed lens barrel, and the sliding lens frame is affixed to the fixed lens barrel.

[Claim 2]

An optical device providing a sliding lens frame capable of sliding relative to a fixed lens barrel in the optical axis direction and in the rotational direction around the optical axis, wherein the fixed lens barrel portion and the sliding lens frame are cam-engaged, and the sliding lens frame is moved by rotating the sliding lens frame relative to the fixed lens barrel;

and wherein by engaging an affixing screw member to the fixed lens barrel and clamping the sliding lens frame using two clamping members engaged to said affixing screw member, the affixing screw member is affixed to the sliding lens frame, and the sliding lens frame is affixed to the fixed lens barrel.

[Claim 3]

The optical device of Claims 1 or 2, wherein the cam engagement between the fixed lens barrel portion and the sliding lens frame is constituted by a cam groove provided in the sliding lens frame and a cam pin member disposed on the fixed lens barrel portion.

[Claim 4]

The optical device of Claims 1 or 2, wherein the cam engagement between the fixed lens barrel portion and the sliding lens frame is constituted by a cam groove provided in the fixed lens barrel portion and a cam pin member disposed on the sliding lens frame.

[Claim 5]

The optical device of Claim 1, wherein the clamping surface of at least one of the two clamping members engaged with the affixing screw member and the clamped surface of the fixed lens barrel portion contacted by the clamping surface are [both] cylindrical surfaces with the same curvature.

[Claim 6]

The optical device of Claim 1, wherein the clamping surface of at least one of the two clamping members engaged with the affixing screw member and the clamped surface of the sliding lens frame contacted by the clamping surface are [both] cylindrical surfaces with the same curvature.

[Detailed Description of the Invention]

[Technical Field]

[0001]

The present invention pertains to optical devices such as rear-projection televisions and rear-projection projectors or other rear-projection video equipment which project enlarged images onto a screen from the rear, and optical devices such as high-resolution surveillance cameras, especially optical devices requiring high-precision optical adjustment and the maintenance of the optical stability of the lens system.

[Background Art]
[0002]
Using the example of a rear projector, [a system] comprises a lower cabinet for housing an image-forming portion, and the main body of the screen itself; an image displayed on a liquid crystal display device of the image-forming portion is projected from the rear surface as an enlarged image (enlarged video) onto the main screen (e.g., see Patent Document 1).

[0003]
Conventional rear-projection video equipment consists of an upper cabinet and a lower cabinet, and comprises a structure that displays by projecting an enlarged image (enlarged video) onto a screen from the rear. A light source and a speaker are located in the lower cabinet (see, for example, Patent Document 2).

[0004]
Conventional rear-projection televisions have a screen and mirror in the upper cabinet, and main components comprising video equipment, drive and control circuits, an optical unit including a projection lens, and a light source in the lower cabinet (see, e.g., Patent Document 3).

[0005]
In a lens systems such as those in the devices disclosed in Patent Documents 1-3, the final fine-tuning of the lens placement is generally done by preparing spacer rings of multiple dimensions and selecting appropriate ones from among these for each device. As another lens position adjustment configuration, an eccentric pin mechanism is used to adjust position by moving a lens holding frame along the optical axis direction.

[0006]
In surveillance camera optical systems, on the other hand, a simple constitution for obtaining a user's desired surveillance picture angle has been proposed in which a variable magnification lens and a focusing lens are each moved separately (see, e.g., Patent Document 4).

I.e., as shown in Figure 8, a variable magnification lens 213 is arranged behind objective lens 220 so as to be movable in the direction of the optical axis 226 of objective lens 220. In addition, a variable magnification lens moving means 214 is provided, having a variable magnification ring 234 for moving variable magnification lens 213 in the direction of the optical axis 226. Behind variable magnification lens 213, a focusing lens 215 is disposed to be movable in the direction of the optical axis 226. Furthermore, a focusing lens moving means 216 is provided, having a focusing ring 217 for moving focusing lens 215 in the direction of optical axis 226.

The variable magnification lens 213 is thus moved on optical axis 226 by the magnification lens moving means 214 to adjust the surveillance viewing angle, and focusing lens 215 is moved on optical axis 226 by focusing lens moving means 216 to focus light beams [from] the object onto imaging surface 250.

[0007]
A variable magnification affixing screw 236 is screwed onto variable magnification ring 234. Screwing in the variable magnification affixing screw 236 brings the tip of the screw into contact with lens barrel 218. This affixes the variable magnification ring 234 to lens barrel 218, thereby fixing the variable magnification state, i.e., the surveillance viewing angle. The variable magnification fixing screw 236 is also used as a grip when moving variable magnification ring 234 in the optical axis 226 direction.

[0008]
[Patent Document 1] Japanese Published Unexamined Patent Application 2003-274314 (Figs. 1-7)
[Patent Document 2] Japanese Published Unexamined Patent Application H9-98359 (Figs. 1-3)
[Patent Document 3] Japanese Published Unexamined Patent Application H9-98357 (Figs. 1-6)
[Patent Document 4] Japanese Published Unexamined Patent Application H7-113941 ([0006], [0007], first page, Fig. 1)

[Disclosure of the Invention]
[Problems the Invention Seeks to Solve]

[0009]
In the rear projection televisions disclosed in the above-described Patent Documents 1-3, the object image distance, i.e., the distance from the image display device to the screen, is extremely short, e.g., 60cm to 90cm, and in order to accommodate all components in a thin housing, the projection magnification is high at 40X to 100X, thus requiring that the focus and projection lens be adjusted with high precision.

[0010]
In such a configuration, selection and incorporation of a desired spacing ring from among the many spacing rings noted above requires that a large number of rings be prepared, leading to high cost and a large number of man-hours for selection and incorporation thereof.

[0011]
The mechanism for positioning the lens holding frame along the optical axis using the above-described eccentric pin requires a small gap in the mating area between the fixed lens barrel and the lens holder frame. The existence of this gap may cause the lens to become eccentric due to rotation of the eccentric pin.

[0012]

For the surveillance camera disclosed in Patent Document 4, the camera body including imaging lens is disposed on a poorly accessible ceiling or other high location, left physically unattended for long periods of time, and requires a high degree of imaging clarity.

For these reasons, the lens system of the optical device described above, particularly the imaging lens, must be precisely adjusted relative to the position of its constituent lenses, and the adjusted constituent lenses must be held without, for example, imparting eccentricity, and without time-induced changes over long periods.

[0013]

A variable magnification affixing screw 236 is affixed in the surveillance camera variable magnification ring 234 described in Patent Document 4. This variable magnification affixing screw 236 is screwed into variable magnification ring 234, causing the tip of the screw to contact lens barrel 218. Variable magnification ring 234 is thus affixed to lens barrel 218. Therefore when variable magnification ring 234 becomes affixed to lens barrel 218, lens barrel 218 is deformed by the screwing of variable magnification fixing screw 236 into variable magnification ring 234, or is pressed against affixing screw 236 and displaced in a direction orthogonal to the optical axis. As a result, there is a risk that objective lens 220 and variable magnification lens 213, [respectively] supported by lens barrel 218, may become eccentric.

The same risk exists relative to affixing of the focused state by screwing the focus affixing screw (not shown) into focus ring 217.

[0014]

(Object of the Invention)

The present invention was undertaken in view of problems with conventional optical devices, and has the object of providing an optical device with which the position of at least part of a lens system on the optical axis can be easily adjusted, and in which at least part of the adjusted lens system can be stably fixed for a long period of time without the risk of eccentricity in at least a part of the adjusted lens system.

[0015]

The present invention also has the object of providing an optical device that does not require preparation of a large number of spacer rings, does not incur large costs, and does not require a large number of man-hours for selection and incorporation of a large number of components.

[0016]

The first invention is an optical device providing a sliding lens frame capable of sliding relative to a fixed lens barrel in the optical axis direction and in the rotational direction around the optical axis, wherein the fixed lens barrel portion and the sliding lens frame are cam-engaged, and the sliding lens frame is moved by rotating the sliding lens frame relative to the fixed lens barrel;

and wherein by engaging an affixing screw member to the sliding lens frame and clamping the fixed lens barrel portion using two clamping members engaged to said affixing screw member, the affixing screw member is affixed to the fixed lens barrel, and the sliding lens frame is affixed to the fixed lens barrel.

[0017]

The second invention is an optical device providing a sliding lens frame capable of sliding relative to a fixed lens barrel in the optical axis direction and in the rotational direction around the optical axis, wherein the fixed lens barrel portion and the sliding lens frame are cam-engaged, and the sliding lens frame is moved by rotating the sliding lens frame relative to the fixed lens barrel;

and wherein by engaging an affixing screw member to the fixed lens barrel and clamping the sliding lens frame using two clamping members engaged to said affixing screw member, the affixing screw member is affixed to the sliding lens frame, and the sliding lens frame is affixed to the fixed lens barrel.

[0018]

Embodiments of the first and second inventions are as follows.

The cam engagement between the fixed lens barrel portion and the sliding lens frame is constituted by a cam groove provided in the sliding lens frame and a cam pin member placed on the fixed lens barrel portion.

The cam engagement between the fixed lens barrel portion and the sliding lens frame is constituted by a cam groove provided in the fixed lens barrel portion and a cam pin member disposed on the sliding lens frame.

[0019]

In an embodiment of the first invention, the clamping surface of at least one of the two clamping members engaged with the affixing screw member and the clamped surface of the fixed lens barrel portion contacted by the clamping surface are [both] cylindrical surfaces with the same curvature.

In an embodiment of the second invention, the clamping surface of at least one of the two clamping members engaged with the affixing screw member and the clamped surface of the sliding lens frame contacted by the clamping surface are [both] cylindrical surfaces with the same curvature.

[Effect of the Invention]

[0020]

The optical device of the present invention has the effect that at least a part of the lens system can be easily precisely adjusted, and at least a part of the adjusted lens system can be stably fixed without eccentricity.

[0021]

The optical device of the present invention also has the effect of enabling the constitution of an optical device of desired high precision without requiring the preparation of many spacing rings, without requiring large costs, and without requiring man-hours to select among and build in many components.

[0022]

The optical device of the present invention has the effect, in particular, of not using an eccentric pin, not requiring a small gap in the mating portion between a fixed lens barrel and a lens holding frame, and eliminating the risk of lens eccentricity due to the existence of this gap.

[0023]

Optical devices in embodiments of the present invention are explained below based on figures.

(First Embodiment)

Optical device 10 of the first embodiment is a projection lens system for rear-projection type video equipment such as rear-projection televisions and rear-projection projectors. As shown in Figure 1, optical device 10 has a product mounting flange portion 12 and a fixed lens barrel portion 14 integrally molded from synthetic resin material.

An imaging lens 20 consisting of lenses 1-8, as shown in Figure 2, is disposed within fixed lens-barrel portion 14. Lenses 3-8 are supported more fixedly in a known constitution. Lenses 1 and 2, whose position on the optical axis greatly affects the image formation performance and focal length of imaging lens 20, are supported in such a way that [their] position on the optical axis can be adjusted by a lens position adjustment mechanism 30.

[0024]

As shown in Figure 2, [in] lens position adjustment mechanism 30 a sliding lens frame 32 supporting lenses 1 and 2 is slidably disposed at the tip end of fixed lens barrel portion 14, i.e., on the inside of the end portion opposite the product mounting flange portion 12.

[0025]

As shown in Figures 1 and 2, a circumferential sliding groove 34 is formed on fixed lens barrel portion 14 extending in a plane perpendicular to the optical axis.

In addition, as shown in Figure 2, three inward-facing cam studs 75 are implanted in fixed lens barrel 14, respectively engaging the three cam grooves 40 on sliding lens frame 32, described below. Cam studs 75 consist of a metal pin member 76, attached to which is a buffer ring 77 made of a material with low frictional resistance; buffer ring 77 is sliadably engaged with a cam groove 40.

[0026]

As shown in Figure 3, in sliding lens frame 32 a straight sliding groove 38 extending in the optical axis direction is formed on a cylindrical sliding surface part 36 that slidably engages the inner surface of fixed lens barrel portion 14. Three cam grooves 40 for adjusting the positions of lenses 1 and 2 in the optical axis direction are formed on the tip end of sliding surface part 36. The three cam studs 75 respectively cam-engage each of the three cam grooves 40.

[0027]

The straight sliding groove 38 of sliding lens frame 32 fits into the sliding stud 44 shown in Figure 4. Sliding stud 44 consists of a columnar part 50 that fits into the straight sliding groove 38 and slides therein, and a flat part 52 that slidably fits into the circumferential sliding groove 34 of fixed lens barrel portion 14. Because columnar part 50 slides [by] making point contact with straight sliding groove 38, there is no risk of a loss of smoothness in this sliding. Flat parts 52 are symmetrically formed on both sides of columnar part 50, so that the problem of orientation need not be considered during assembly. The peak face 56 of columnar part 50 is a cylindrical surface corresponding to the inner cylindrical surface of fixed lens barrel portion 14.

[0028]

A threaded hole 64, coaxial with columnar part 50, is formed in the two flat parts 52. An adjustment fixing screw 62 is screwed into threaded hole 64. As shown in Figure 4, the adjustment fixing screw 62 consists of a small-diameter screw portion 71 which screws into threaded hole 64, a large-diameter screw portion 72 onto which a fastening nut 70 is tightened, and a large-diameter head portion 73 for preventing the fastening nut 70 from being dislodging. The stud surface of head portion 73 has a screwdriving slot 74 for tightening small-diameter screw portion 71 by turning it into threaded hole 64.

[0029]

The optical device of the first embodiment operates as follows.

First, as shown in Figures 1 and 2, [the device] is assembled so that the three cam studs 75 are respectively cam-engaged in each of the cam grooves 40 on sliding lens frame 32. At the same time, adjustment fixing screw 62 is screwed into threaded hole 64 on sliding stud 44, wherein columnar part 50 is slidably engaged with straight sliding groove 38. In this state, cam groove 40 is guided by cam stud 75 through the rotation of adjustment fixing screw 62 around the optical axis. I.e., when adjustment fixing screw 62 is rotated around the optical axis, columnar part 50 moves within straight sliding groove 38. As a result, lenses 1 and 2, supported by sliding lens frame 32, move along the optical axis, adjusting the position of the lenses 1 and 2.

When this positional adjustment is completed, fastening nut 70 is tightened onto large-diameter screw portion 72. At this time, engagement of flat part 52 with circumferential sliding groove 34 prevents the rotation of adjustment fixing screw 62. Tightening of tightening nut 70 causes the columnar part 50 of sliding stud 44 and the tightening nut 70 to clamp fixed lens barrel member 4, so that the sliding lens frame 32, i.e., lenses 1 and 2, is fixed to the fixed lens barrel portion.

[0030]

(Second Embodiment)

An optical device 110 of the second embodiment is shown in Figure 5; those portions with the same constitution as that of optical device 10 in the first embodiment are assigned the same reference numerals, and a description thereof is here omitted. In optical device

110 of the second embodiment, a cam groove 112 is disposed on fixed lens barrel 14, extending within a plane which is tilted relative to a plane orthogonal to the optical axis. Sliding lens barrel 114, which slides on the inner surface of fixed lens barrel portion 14, supports lenses 1 and 2.

[0031]

A circular sliding hole 120 is formed in sliding lens barrel 114. A positioning stud 116 is slidably fitted into circular sliding hole 120 in the radial direction centered on the optical axis. As shown in Figures 6 and 7, positioning stud 116 comprises a columnar part 122 that slidably fits into circular sliding hole 120, and a flat part 124. The flat part 124 engages cam groove 112 and acts as a cam follower. The peak face 123 of columnar part 122 is a cylindrical surface corresponding to the inner cylindrical surface of fixed lens barrel portion 14.

[0032]

Operation of the optical device of the second embodiment is as follows.

First, [the device] is assembled so that the positioning stud 116 columnar part 122 is slidably fit into circular sliding hole 120 and the flat part 124 is slidably fitt into cam groove 112. Meanwhile, adjustment fixing screw 62 is screwed into threaded hole 64 on positioning stud 116. When the adjustment fixing screw 62 is rotated around the optical axis in this state, positioning stud 116 is guided by cam groove 112 and displaced in the optical axis direction. This results in positional adjustment on the optical axis of lenses 1 and 2, supported by sliding lens barrel 114.

Once this positional adjustment is completed, fastening nut 70 is tightened onto large-diameter screw portion 72. When this occurs, engagement of the flat portion 124 with cam groove 112 prevents rotation of adjustment fixing screw 62. Tightening of the tightening nut 70 causes the columnar part 122 of positioning stud 116 and the tightening nut 70 to clamp fixed lens barrel portion 14, so that the sliding lens frame 114, i.e., lenses 1 and 2, are fixed to the fixed lens barrel portion 14.

Industrial Uses

[0033]

Although we have explained the invention using embodiments of projection lens systems in rear-projection video equipment such as rear-projection televisions and rear-projection projectors, the invention can also be effectively implemented in the projection optics of optical equipment such as high-resolution surveillance cameras. The invention can also be effectively implemented in any lens system such as relay optics or illumination optics.

[Brief Description of Drawings]

[0034]

[Figure 1] A perspective view of a product mounting flange and fixed lens barrel portion in a first embodiment of the optical device of the present invention

[Figure 2] A cross-sectional view of the optics and lens barrel in a first embodiment of the optical device of the present invention
[Figure 3] A side elevation of the optics and lens barrel in a first embodiment of the optical device of the present invention
[Figure 4] An explanatory diagram of a stud and coupling screw in a first embodiment of the optical device
[Figure 5] A side elevation of a product mounting flange portion and fixed lens barrel portion, also including a sliding lens barrel in a second embodiment of the optical device of the present invention
[Figure 6] A plan view of a stud in a second embodiment of the optical device of the present invention
[Figure 7] An explanatory diagram of a stud and a coupling screw in a second embodiment of the optical device
[Figure 8] A cross-sectional view of a conventional optical system and lens barrel portion

[Explanation of Reference Numerals]
[0035]
1-8 Lenses
10 Optical device
12 Product mounting flange portion
14 Fixed lens barrel
20 Imaging lens
30 Lens positioning mechanism
32 Sliding lens frame
34 Circumferential sliding groove
36 Sliding surface part
38 Straight sliding groove
40 Cam groove
44 Sliding stud
50 Columnar part
52 Flat part
56 Peak face
62 Adjustment fixing screw
64 Threaded hole
70 Tightening nut
71 Small diameter screw portion
72 Large-diameter screw portion
73 Head portion
74 Screw driving slot
75 Cam stud

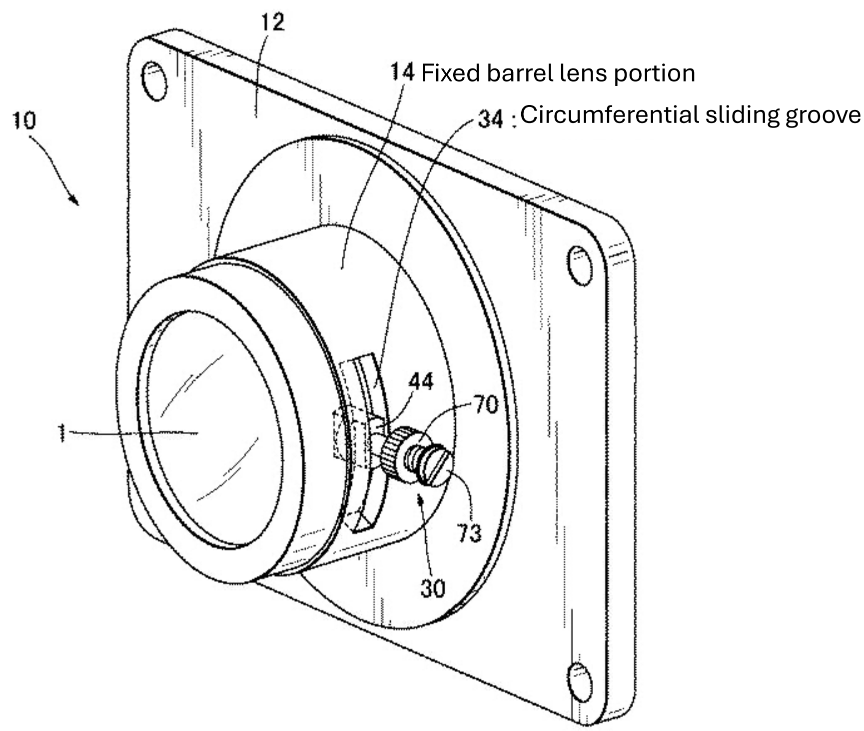

12
14 Fixed barrel lens portion
34 : Circumferential sliding groove
10
44
70
1
73
30

FIG. 1

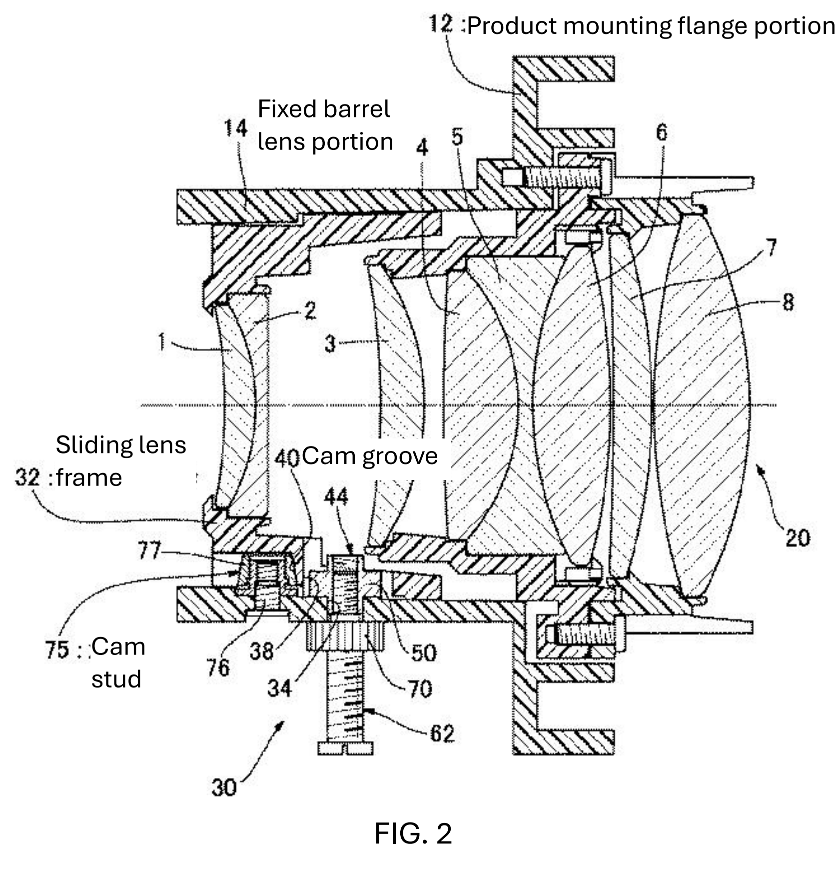

12 :Product mounting flange portion
Fixed barrel
14 lens portion
4
5
6
7
8
2
1
3
Sliding lens
32 :frame
40 Cam groove
44
20
77
75 : Cam
stud
76
38
50
34
70
62
30

FIG. 2

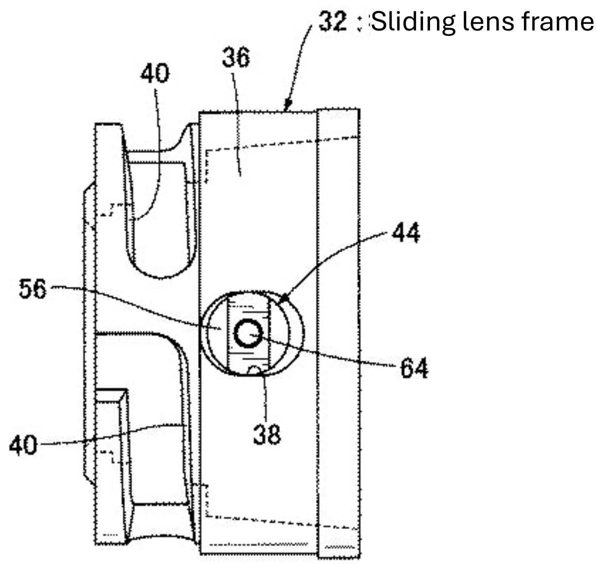

32 : Sliding lens frame
40
36
44
56
64
38
40

FIG. 3

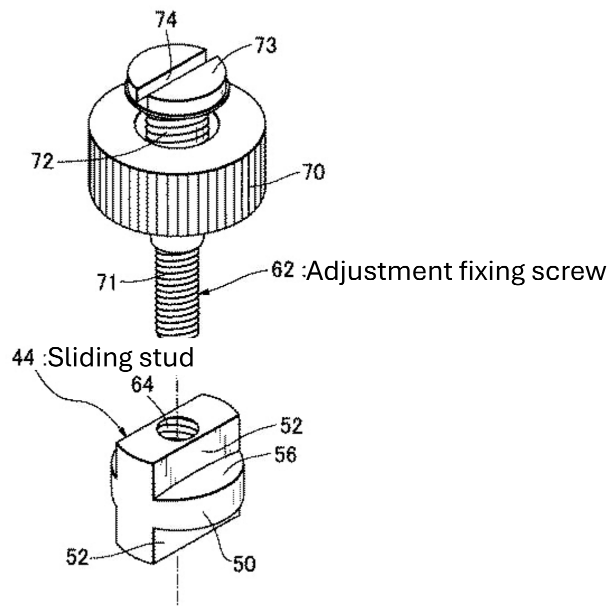

74
73
72
70
71
62 :Adjustment fixing screw
44 :Sliding stud
64
52
56
52
50

FIG. 4

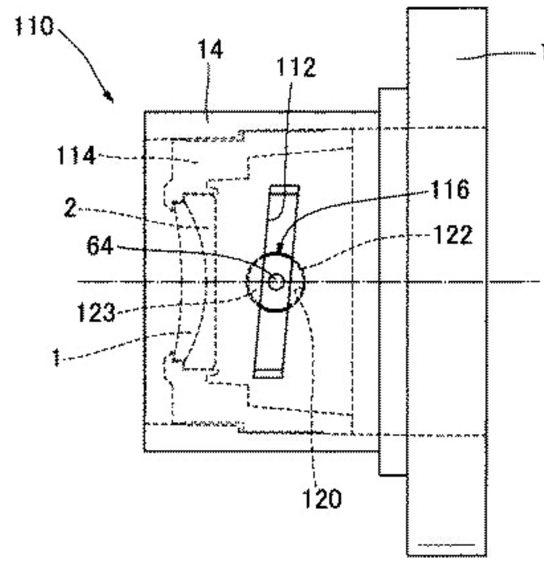


FIG. 5

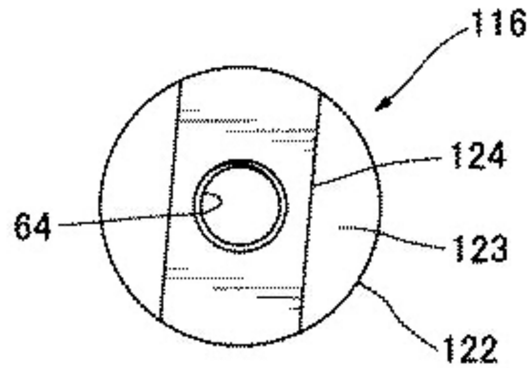


FIG. 6

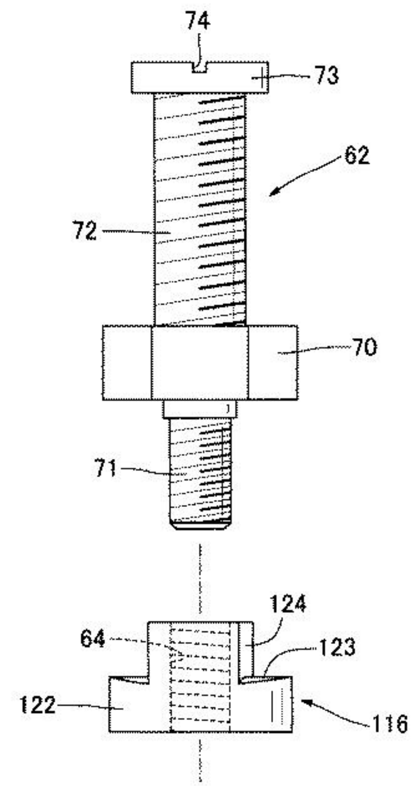

74
73
62
72
70
71
124
64
123
122
116

FIG. 7

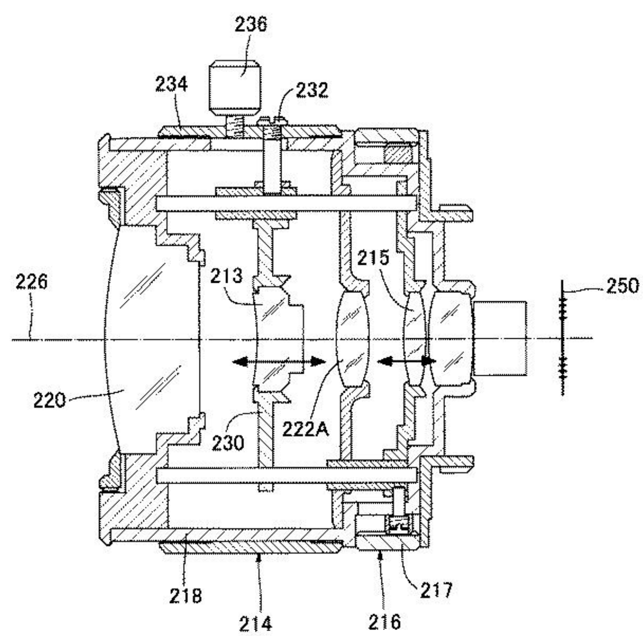

236
234
232
226
213
215
250
220
230
222A
218
214
216
217

FIG. 8